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For: Press Section in a Paper or Board Machine

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**Marked Up Copy of Substitute Specification under 37 C.F.R. 1.125(b)(2)**

**TITLE OF THE INVENTION**

Press ~~[s]~~Section in a ~~[p]~~Paper or ~~[b]~~Board ~~[machine-~~

~~[Machine~~

## **CROSS REFERENCES TO RELATED APPLICATIONS**

-  
5 **[0001] This application is a U.S. national stage application of international app. No. PCT/FI2003/000751, filed Oct. 10, 2003, the disclosure of which is incorporated by reference herein and claims priority on Finnish App. No. 20022057, filed Nov. 19, 2002.**

**STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER  
FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT**

**[0002] Not applicable.**

## **BACKGROUND OF THE INVENTION**

**[0003]** The invention relates to a press section in ~~a paper or board machine according to the preamble of claim 1.~~

~~The invention relates to~~ a paper or board machine which is provided with at least a forming section, a press section and a dryer section and in which the press section is provided with separate press nips. In this patent application, by a separate press nip is meant a press nip in which opposing press members define only one press nip. A separate press nip can be a roll nip or an extended nip. The opposite of a separate press nip is a press which is provided with a ~~centre~~center roll and in which the ~~centre~~center roll forms press nips with at least two other rolls.

**[0004]** FI patent application 990557 discloses a method and an arrangement for treating a paper or board web. Figs. 4-6 show control of the surface properties of a web with chemicals, and examples suitable for a smoothing press nip. In these exemplifying embodiments, a tandem transfer belt is used underneath in the second and third nips. Dewatering is not symmetric because dewatering takes place in both directions in the first nip, upwards in the second nip, and no dewatering takes place in the third nip, but, instead, there is smoothing and application of the web because belts are placed on both sides of the web. Thus, the third press nip of these embodiments does not increase dry solids even though it improves the surface properties of the web, thus increasing the overall length of the paper machine.

**[0005]** FI patent 95610 discloses a press section of a paper machine provided with a smoothing press. The paper web has a closed and supported draw through the press section and the press section comprises at least two successive separate press nips, dewatering of the paper web being carried out at least in the first one of said press nips, preferably between two press fabrics that receive water. The last press nip in the press section is a smoothing press nip which is separate from the preceding nip and in which no substantial dewatering is performed. The paper web is passed through the smoothing press nip from the preceding dewatering press nip on a transfer belt substantially not receiving water, on its substantially straight run, which

is continued after the smoothing nip as a run of substantially the same direction, on which run some of the elongation of the paper web in the machine direction can be compensated for, which elongation takes place in the smoothing nip, by a difference in speed of the transfer belt.

5     **[0006]** US ~~{patent}~~**Pat. No. 6,121,053** discloses a press section and a method for pressing with shoe presses of different lengths. Fig. 2 shows an embodiment comprising three shoe press units in which the web is first passed through the first and the second shoe press unit which are placed underneath a counter roll, i.e. underneath the web, and the third shoe press is placed above a counter roll, i.e.  
10     above the web.

**[0007]** FI patent application 981089 discloses a press section of a paper machine applying one or more press nips, through which the paper web to be pressed is passed as a substantially closed draw and in which press section there is at least one press nip provided with two water-receiving press felts, through which press nip the  
15     paper web runs between the press felts and after which last-mentioned nip the paper web is separated from one of the press felts and transferred on support of the other press felt substantially as a closed draw further. The last nip in the press section is an extended nip zone, in which one roll is a shoe roll provided with a hose shell and with a press shoe arrangement and the other roll is a press suction roll provided with  
20     a suction zone. The paper web is passed through the last extended nip zone between two water-receiving press fabrics and directly after the last extended nip zone the paper web is separated from one of the press fabrics and transferred, with the aid of a vacuum present in a suction zone of said press section roll, to follow the press fabric placed at the side of said press suction roll without substantial rewetting, and the  
25     paper web is passed on the latter press fabric as a closed draw onto a drying wire or equivalent of a dryer section following after the press section, onto which drying wire or equivalent the web is transferred as a suction roll transfer or by means of an equivalent arrangement.

**[0008]** FI patent application 961518 discloses press section geometries in which a press section provided with a closed draw of a web in a paper or board machine comprises a first water-receiving upper fabric onto which the web is transferred on a suction zone of a pick-up roll from a forming wire at a pick-up point situated after its suction roll and after that there is a wire drive roll, from which the return run of the wire begins. The press comprises one or two successive press nips which press water from the web and between which the web has a totally closed draw such that it is supported by a fabric all the time. The press nips removing water are so-called extended nips, whose press zone is substantially longer than that of a sharp roll nip, and all press nips are additionally provided with two water-receiving press fabrics so that water is removed in them substantially symmetrically through both surfaces of the web. In addition, the embodiments shown in Figs. 1, 2 and 3 make use of a lightly loaded transfer nip, which nip is defined by a press roll, provided with a recessed surface and disposed within an upper wire loop, together with a first drying cylinder or equivalent.

**[0009]** One problem in the press sections known in the state of the art is absorption asymmetry, which is caused because the composition/structure of the web in the thickness direction changes in every pressing operation in which water is not removed in an equal amount in both directions because some of the fines and filler material of the web is washed with water. Fines accumulate in the surface parts of the web where dewatering has been stronger. The problem can also be affected in a wire section but the press is the last dewatering member by which the problem can actually be affected. Even in good paper, the middle layer becomes poor in fines but on both sides of the web there is an equal amount of fines moving and adhering close to the surfaces.

**[0010]** In surface topography, missing dots in the print and the absorption of the top and bottom surfaces of paper and its asymmetry are a significant drawback in modern press sections having a closed draw when these are applied to printing paper. When the speed increases so that it is over 2000 m/min, closed draw provides

a considerable runnability benefit in speed potential and efficiency. One object of the invention is to develop further a press section that has a closed draw and is suitable for speeds over 1800 m/min and advantageously over 2000 m/min, at which there are no problems with surface topography and absorption symmetry described above.

## SUMMARY OF THE INVENTION

**[0011]** One object of the invention is to provide a press section of a paper or board machine which makes it possible to optimize surface topography and absorption at a speed over 1800m/min and advantageously over 2000 m/min.

5 ~~{With a view to achieving the objects described above as well as those which will come out later, the press section according to the invention is mainly characterized in what is stated in the characterizing part of claim 1.}~~

**[0012]** In the press section of a paper or board machine in accordance with the invention, closed draw through the press section is accomplished as a substantially  
10 straight run and the press section includes at least three separate press nips which do not have any fabric loops in common with one another.

**[0013]** In the press section in accordance with the invention, the first press nip in the running direction of the web is a roll nip or a press suction roll nip, advantageously at lower speeds of over 1800 m/min, but with speeds increasing over  
15 2000 m/min and with increasing dewatering need, an extended nip becomes an advantageous alternative. It is conceivable that in the case of three nips at high speeds all the nips are extended nips and, on the other hand, in the case of more nips than three at a lower speed mere roll nips can be used. The next two nips each have only one water-receiving fabric, which is placed in each nip on the opposite side of  
20 paper with respect to the other nip in the machine direction. In said successive nips, both sides of the web are smoothed/evened out one at a time mechanically against a smooth surface, which smooth surface can be a smooth roll, known from a ~~{centre}~~**center** roll arrangement, or a transfer belt. In that connection, removal of water from the web takes place in the nip only in a direction away from the smooth  
25 surface, i.e. to the side of the water-receiving fabric. By this means, in the successive nips an equal amount of fines affecting absorption is provided in the vicinity of both surfaces.

**[0014]** Transfer from the press section in accordance with the invention to a dryer



section takes place, as known in itself, from a transfer belt, and in the embodiments in which a smooth surface is in an upper position in the last nip of the press section, transfer from a lower felt is used.

5 **[0015]** In the smoothing/evening out nips provided with a smooth roll or a transfer belt in the press section in accordance with the invention, there is a water-receiving press fabric and a press roll on the other side. With lower load needs it is possible to use an ordinary press suction roll, and at higher loads it is advantageous to use a press suction roll that is manufactured by means of powder metallurgy, in which case the wall thickness of the suction roll need not be increased. For example, by 10 means of the suctions of the last smoothing nips it is ensured that the web follows the felt, and a high load is not necessarily needed. Similarly, in the roll/extended nips at the beginning, increased dewatering is achieved by means of a higher load using a suction roll of powder metallurgy. A press suction roll manufactured by means of powder metallurgy is described, for example, in FI patent 100422. The suction roll 15 assures that the web remains on the surface of a porous fabric so that it shall not start following the more adhesive smooth surface of a roll/transfer belt. The smooth surfaces of press nips also affect the surfaces of the web mechanically, evening out the decrease of smoothness caused by coarse press fabrics. Shoe presses can also be used in connection with the invention.

20 **[0016]** The press section in accordance with the invention provides good surface properties of the web in respect of printability and also makes it possible to use high speeds, over 1800 m/min and advantageously over 2000 m/min, and enable good efficiency with a good moisture profile.

25 **[0017]** The press section in accordance with the invention also facilitates the adjustment of two-sidedness that takes place further in the paper machine line and which can be performed mainly by means of calendering and application of chemicals. The bulk possibly lost during pressing can be saved later by means of lighter calendering, which can be optimized further according to other desired

surface properties, as there is no need to correct absorption symmetry. On the other hand when press dry solids increase in more press nips than conventional, it may be possible to manage with a shorter dryer section even though the press section becomes longer.

5     **[0018]** In one advantageous embodiment of the invention there are three press nips, a closed draw of the web through the press section and, in the first nip, dewatering takes place on two sides, thus providing a symmetric web. After the first nip, the web is transferred from the surface of an upper felt to a second press and, in the second nip, dewatering takes place downwards and the upper surface of the web  
10     is either against a smooth roll or a smooth transfer belt. In the third nip, dewatering takes place upwards and the lower surface of the web is against a transfer belt and the transfer of the web is from a lower fabric to a dryer section. In accordance with one advantageous additional feature, a roll press is placed after the first nip in the second press, whereby a sufficient material displacement is achieved in the second  
15     nip, i.e. displacement of fines to the side of the lower surface of the web. At the same time, the smoothness of the upper surface of the web improves because it is pressed against a smooth surface.

**[0019]** In the following, some embodiments of the invention are described with reference to the figures of the appended drawings, but the invention is not meant to  
20     be exclusively limited to the details of the figures.

**{Figure1A}**

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0020]** **FIG.1A** is a schematic view of one embodiment of the invention.

~~{Figure}~~**[0021]** **FIG. 1B** is a schematic view of one variant of the first press nip in the embodiment of the invention shown in ~~F~~**fig****IG. 1A.**

5 ~~{Figure}~~**[0022]** **FIG. 2A** is a schematic view of a second embodiment of the invention.

~~{Figure}~~**[0023]** **FIG. 2B** is a schematic view of one alternative application of the embodiment of the invention shown in ~~F~~**fig****IG. 2A.**

~~{Figure}~~**[0024]** **FIG. 3** is a schematic view of a third embodiment of the invention.

10 **[0025]** In the following figures, the same reference numerals are used of parts that correspond to one another.

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## **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

**[0026]** In **Fig. 1A**, a web W formed in a forming section is passed to a pick-up point P situated on a forming wire 10 before reversing rolls 11, 12 placed within the loop of the forming wire 10. The pick-up point P is formed between the forming wire 10 and a roll 24 placed within the loop of a first water-receiving press felt 20 and provided with a suction sector 24a, so that the web W runs at the pick-up point P between the forming wire 10 and the first press felt 20. At the pick-up point P, the web W is separated from the forming wire 10 and transferred to be supported by the first press felt 20. After that, the web W is transferred on support of the lower surface of the first press felt 20 to a first press nip N1, which is defined by two recessed surface press rolls 22 and 23 to form therebetween a roll nip N1 or a press suction roll nip (**Fig. 1B**), in which case the upper roll 22 is a press suction roll provided with a suction zone and the other roll 23 is a recessed surface roll. In that connection, a felt suction roll 25 can be omitted. The web W runs in the first press nip N1 between the first water-receiving press felt 20 serving as an upper press fabric and a first water-receiving press felt 21 serving as a lower press fabric. Dewatering of the web W takes place in the first press nip N1 into both press felts 20, 21. In the embodiments which use a press suction roll, water is also removed through a suction zone into the suction roll.

**[0027]** After the first press nip N1, the travel of the web W with the upper press felt 20 is assured by means of a vacuum in a suction zone 25a of an upper suction roll 25, and the web W is separated from the first press felt 20 by means of a vacuum in a suction zone 34a of a lower transfer suction roll 34 and caused to adhere to a second lower press fabric 30, which may also be a press felt, on the upper surface of which the web W is transferred to a second press nip N2, which is defined between a roll 32 and a press suction roll 33 provided with a suction zone 33a. The suction zone 33a of the suction roll 33 preferably has a large sector and a high vacuum, assuring that the web adheres to the desired felt already before the press nip and follows the felt after the nip in order that the web should not follow the smooth roll. After that, the web W is transferred on support of the second press fabric 30 and

transferred by means of a suction zone 44a of a transfer suction roll 44 to be supported by a subsequent upper press felt 40 and to a third press nip N3, which is defined between an extended nip press roll 42 and a counter roll 43. Underneath there is a transfer belt 41, by means of which the web W is passed to a transfer suction roll 54 having a suction zone 54a, by means of which the web is transferred onto a drying wire 50 of a dryer section. Dewatering of the web W takes place in the third press nip N3 into the upper press felt 40.

**[0028]** The embodiment shown in **Fig. 2A** mainly corresponds to the embodiment described in connection with **Fig. 1A** and its variants, but in the embodiment shown in **Fig. 2A**, the second press nip N2 is formed such that in the second nip 42 there is an upper transfer belt 31 and as the lower fabric 30, as in the embodiment shown in **Fig. 1A**, there is a press felt 30. From the second nip N2 the web W is passed on the lower surface of the transfer belt 31 onto a transfer fabric 60, onto which the web W is transferred by means of a suction zone 64a of a transfer suction roll 64 and on support of the felt 60 the web W is passed by means of a suction zone 44a of a suction roll 44 to be transferred so as to be supported by the upper fabric 40 of the third press nip N3.

**[0029]** The embodiment of the invention shown in **Fig. 2B** mainly corresponds to the embodiment shown in **Fig. 2A** except that each nip N1, N2, N3 has been formed into an extended nip, in which one roll is an extended nip roll 22; 33; 42 and the other roll is its counter roll 23; 32; 43.

**[0030]** **Fig. 3** shows an embodiment of the invention in which the web W is passed from a forming wire 10 of a forming section before a reversing roll 11 to a pick-up point P, at which the web W is passed by means of a suction zone 24a of a suction roll 24 so as to be supported by a first water-receiving press felt 20 and the web W is passed to a first press ~~nip N1~~ **nip N1**, which is defined between two recessed surface press rolls 22, 23 or between a press suction roll and a recessed surface press roll (as in **Fig. 1B**). A lower press felt 21 also receives water.

Adherence to the surface of the lower press felt 21 is assured by means of a vacuum in a suction zone 26a of a transfer suction roll 26 and the web W is passed by means of a vacuum in a suction zone 35a of a suction roll 35 so as to be supported by an upper press felt 31 of a second press nip N2. The second press nip N2 is formed into an extended nip press between an extended nip roll 32 and a counter roll 33. The lower fabric in this press nip N2 is a water-receiving press felt 30. On its support the web W is passed onto a transfer suction roll 44, and by means of a vacuum in a suction zone 44a of the transfer suction roll 44 the web W is passed to be supported by an upper felt 40, on which the web is passed to a third nip N3, which is a smoothing press nip formed between rolls 42 and 43. The roll 42 is a press suction roll which is provided with a suction zone 42a. Dewatering takes place into a suction zone 42a of the suction roll. The web is passed from the felt 40 to a subsequent felt 70 by means of a vacuum in a suction zone 74a of a suction roll 74, and by means of the felt 70 the web is passed to a subsequent smoothing nip N4 formed between a press suction roll 73 and a suction roll 72. The suction zones 42a and 73a of the suction rolls 42 and 73 preferably have a large sector and a high vacuum, assuring that the web adheres to the desired felt already before the press nip and that it follows the felt after the nip in order that the web should not follow the smooth roll. After that, the web W is passed to a dryer section to be supported by a drying wire 50, as described above in connection with Figs. 1A and 2A. The embodiment in accordance with ~~FIG. 3~~ **FIG. 3** can also be accomplished such that only one press nip that receives water in both directions is placed before the smoothing press nips N3, N4, in that case in the first press nip N1 there can be a nip defined by a shoe roll and a recessed surface roll or a nip defined by a shoe roll and a press suction roll.

**[0031]** Above, the invention has been described with reference to some of its advantageous exemplifying embodiments only, but the invention is by no means meant to be narrowly limited to the details of them.